

Investigation of the characteristics and epidemiology of animal bites-a multicenter study

Animal bite epidemiology: A multicenter study

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Abstract

Aim: This study evaluated applications due to contact with animals that occurred in a metropolitan city center and a rural district center and aimed to compare patients' demographic and medical conditions in order to determine the risk factors for animal attacks.

Material and Methods: This study was conducted retrospectively and was multicenter. Patients who had been attacked by cats, dogs, and other animals (horses, cows, donkeys) and therefore admitted to the emergency department for the first time were included in this study. The obtained data from the city center and the district center were compared.

Results: In the comparison of the data from the two centers, the findings showed that while the rate of female patients (52.69%) was higher in the city center, the majority of the patients who applied to the emergency department in the district center were male (69.92%) ($p < 0.00$). It was observed that lower extremity injuries (35.91%) were more common in the city center in terms of the injured area, and biting injuries were higher (64.09%) regarding injury type.

Discussion: As in our country, in countries where the number of stray animals is high, animal vaccinations cannot be administered fully and adequately. Algorithms have been developed to create a common approach to animal bites in our country. However, different approaches and treatment protocols can be encountered in the world. These differences may be due to geographical, sociocultural, and socioeconomic reasons. Therefore, regarding animal contact identifying at-risk groups may contribute to reducing animal attacks. In this study, to our knowledge, for the first time, the risk factors for exposure to animal attacks in rural and urban areas were investigated in the literature.

Keywords

Rabies, Animal Bite, City Center, District Center, Multicenter Study

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Introduction

Animal bite injuries represent a major global health issue [1]. Patients attacked by animals occupy a crucial place among emergency department admissions. In the USA alone, approximately 4.7 million people are injured by animals and apply to the emergency department yearly and 2% of these patients need hospitalization [2]. Rabies, transmitted from animals, is an essential cause of mortality. Rabies causes approximately 59,000 deaths annually worldwide [3]. Rabies is a significant public health problem in Turkey, where this study has been conducted, and worldwide. The Ministry of Health has created algorithms to approach patients with risky contact, and standard treatment protocols have been developed for wound care and rabies prophylaxis (available at: <https://hsgm.saglik.gov.tr/tr/zoontikvektorel-kuduz/zoontikvektorel-kuduz-rehber>, Accessed on Nov 28, 2022). Despite the improvements in modern medicine, the only remedy for rabies remains preventive health services. The most important preventive measures are avoiding people from animal attacks and vaccination. Thus, an animal protection law has been enacted to minimize animal contact and potential rabies exposures. This law includes vaccination and reclamation of stray animals. Despite all the precautions taken, the number of applications to hospitals after contacting animals is approximately 295,000 people per year (available at: <https://hsgm.saglik.gov.tr/tr/zoontikvektorel-kuduz/istatistik.html>, Accessed on Nov 28, 2022). In various research from our country and other countries, exposure to different animal species in different regions has been reported [4-6]. However, there are few multicenter publications in the literature, comparing regional differences and revealing contact risks.

This study evaluated applications due to contact with animals that occurred in a metropolitan city center and a rural district center and aimed to compare patients' demographic and medical conditions in order to determine the risk factors for animal attacks.

Material and Methods

This study was conducted retrospectively and as a multicenter study. After approval of the ethics committee (No. 0255 and date: 2022-05-26), patients who applied to the provincial center tertiary care emergency service and the district center second-level hospital emergency service between January 1, 2019, and January 31, 2022, were assigned according to ICD-10 codes (Z24.2, A82, Z20.3) by examining the records in the automation system.

Inclusion Criteria

Patients who were attacked by cats, dogs, and other animals (horses, cows, donkeys) and therefore admitted to the emergency department for the first time were included in this study.

Exclusion Criteria

Pregnant women, patients who had previously started rabies prophylaxis and applied for the next vaccine dose, and patients whose files could not be accessed were excluded from the study.

Primary Outcomes

Age and gender of the patients, season of injury, injured body area, injury type (bite-scratch), vaccines and treatments applied

to the patients, attacking animal (cat, dog, horse, cow, donkey), whether animal is domestic or stray animal, and 1st month outcomes of the patients (discharge/service/intensive care admission, rabies development and mortality) were recorded. The data obtained from the city center and the district center were compared.

Statistical Method

The obtained data were evaluated with the IBM SPSS Statics Version 20 program. Descriptive statistics, frequency, percentage distribution, mean, standard deviation, and minimum and maximum values for continuous variables were calculated. The suitability of continuous variables to normal distribution was evaluated with the Kolmogorov-Smirnov and Shapiro-Wilk ($p < 0.05$) tests. Then, it was decided to use parametric or non-parametric tests accordingly. While chi-square tests statistics were used for comparing categorical variables between groups, the Mann-Whitney U statistical analyses were used for comparisons between the two groups since the continuous data consisted of values that did not appear convenient to normal distribution. The conformity of the age variable to the normal distribution was checked with the Kolmogorov-Smirnov and Shapiro-Wilk tests, and it was decided to use non-parametric tests (age $p = 0.00 < 0.05$). Post hoc analysis was performed for the variables to which chi-square test statistics were applied, and differences between subgroups were determined. In addition, the sub-factors affecting the animal attack situation in the city center and district center were evaluated by CHAID analysis.

Ethical Approval

Ethics Committee approval for the study was obtained.

Results

A total of 721 patients from the city and district centers were included in the study. In the comparison of the data from the two centers, the findings showed that while the rate of female patients (52.69%) was higher in the city center, the majority of the patients who applied to the emergency department in the district center were male (69.92%) ($p < 0.00$). It was observed that lower extremity injuries (35.91%) were more common in the city center in terms of the injured area and biting injuries were higher (64.09%) regarding injury type (Table 1).

Given the differences between the city center and the district center according to the seasons, it was observed that the number of applications was higher in autumn for the city center (18.28%), whereas it was higher in spring for the district center (41.02%) ($p < 0.00$). Regarding animal species, dog injuries were more common in the district center, while cat injuries were more common in the city center. ($p < 0.05$). Domestic animal attacks were more common in the district center ($p < 0.00$) (Table 2).

While the vaccination rates were 100% in the district center, this rate was 96.99% in the city center ($p < 0.00$). Immunoglobulin (Ig) application was higher in the city center ($p < 0.00$). The rate of patients who underwent surgery, suture, and antibiotic (AB) applications was higher in the city center ($p < 0.05$) (Table 3). None of the patients included in the present study developed rabies or died. No allergies developed in any patient who received Ig.

In the CHAID analysis conducted to determine the sub-factors

Table 1. Comparison of the demographic characteristics of the patients and type of injury who applied to the provincial center and the district center.

Variables	All patients (N=721)			P	
	Mean ± SD	District center (n=256)	Provincial center (n=465)		
	(Min - Max)	(Min - Max)	(Min - Max)		
Age	36,69±14,99 (1-81)	38,38±12,63 (3-81)	35,76±16,09 (1-79)	0	
Gender	n (%)	n (%)	n (%)	0	
	Male	399 (55,34)	179 (69,92)		220 (47,31)
Body injury site	Female	322 (44,66)	77 (30,08)	245 (52,69)	0,1
	Upper Extremity	355 (49,24)	137 (53,52)	218 (46,88)	
	Lower Extremity	237 (32,87)	70 (27,34)	167 (35,91)	
	Head Neck	103 (14,29)	41 (16,02)	62 (13,33)	
	Multiple	26 (3,61)	8 (3,13)	18 (3,87)	
Being Bitten/Scratched	Being Bitten	426 (59,08)	128 (50,0)	298 (64,09)	0
	Scratched	295 (40,92)	128 (50,0)	167 (35,91)	

Table 2. Comparison of the seasonal situation the injury and animal species the provincial center and the district center.

Variables	General (N=721)			P	
	n (%)	District center (n=256)	Provincial center (n=465)		
Season of exposure	Summer	184 (25,52)	55 (21,48)	129 (27,74)	0
	Winter	211 (29,26)	73 (28,52)	138 (29,68)	
	Autumn	108 (14,98)	23 (8,98)	85 (18,28)	
	Spring	218 (30,24)	105 (41,02)	113 (24,3)	
Animal Species	Dog	424 (58,81)	174 (67,97)	250 (53,76)	0
	Cat	256 (35,51)	64 (25,00)	192 (41,29)	
	Other (Horse, cow, donkey, rat)	41 (5,69)	18 (7,03)	23 (4,95)	
Domestic/Stray Animal	Domestic	393 (54,50)	188 (73,43)	205 (44,50)	0
	Stray	328 (45,49)	68 (26,56)	260 (55,50)	

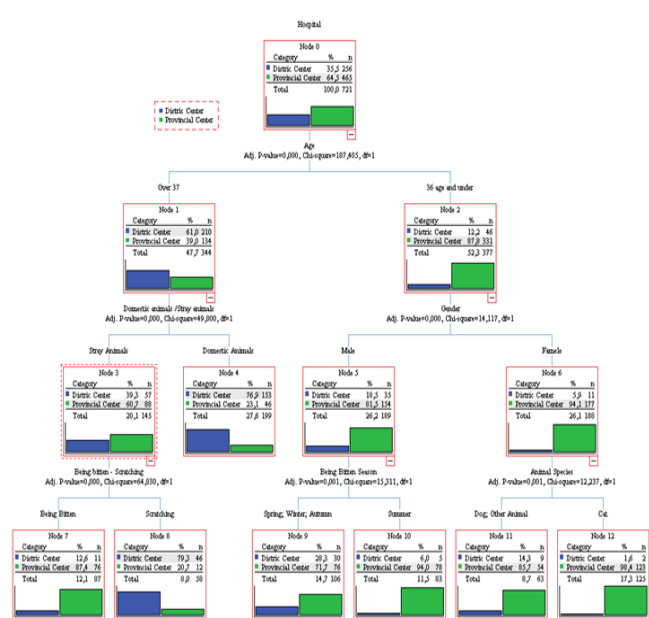


Figure 1. CHAID analysis to determine the sub-factors affecting the animal attack risks of patients in the province center and district center.

Table 3. Comparison of treatment and vaccination status of patients applying to the city center and district center.

Variables	General (N=721)			P	
	n (%)	District center (n=256)	Provincial center (n=465)		
Vaccination	Vaccinated	707 (98,06)	256 (100)	451 (96,99)	0,01
	Not Vaccinated	14 (1,94)	0 (0)	14 (3,01)	
Ig	Ig done	76 (10,54)	16 (6,25)	60 (12,90)	0,01
	Ig not done	645 (89,46)	240 (93,75)	405 (87,10)	
Number Of Vaccinations	Full dose Vaccinated	629 (87,24)	224 (87,50)	405 (87,10)	0,88
	Unfollow	92 (12,76)	32 (12,50)	60 (12,90)	
Treatment	Surgery+Suture+Antibiotic	11 (1,52)	0 (0)	11 (2,37)	0
	Dressing	665 (92,25)	240 (93,75)	425 (91,41)	
	Dressing+Antibiotic	6 (0,83)	0 (0,0)	6 (1,29)	
	Suture	11 (1,53)	11 (4,3)	0 (0,0)	
	Suture+Antibiotic	28 (3,88)	5 (1,95)	23 (4,95)	
Hospitalization	Hospitalized	38 (5,27)	8 (3,13)	30 (6,45)	0,06
	Not Hospitalized	683 (94,73)	248 (96,88)	435 (93,55)	

affecting the animal attack status of the patients in the city center and district center, the city center and district center were considered as the dependent variables. It was found that 35.5% of the cases included in this study applied to the district center and 64.5% to the city center. The primary independent variable affecting the dependent variable was the age of the patients. According to the efficiency of the age variable, the patients were divided into two groups: age ≥ 37 group 1 (n=344) and age < 37 group 2 (n=377).

Of the patients in group 1 (age ≥ 37), 61.0% applied to the hospital in the district center. The most effective factor among group 1 variables was the domestic/stray animal variable and 60.7% of the patients injured by stray animals applied to the hospital in the city center. The third factor affecting this group was the type of injury (bite/scratch). 87.4% of the cases who were bitten by stray animals applied to the hospital in the city center. 79.3% of the patients scratched by stray animals were in the district center. 76.9% of those injured by domestic animals applied to the hospital in the district center. No other affecting factor was found for the patients injured by domestic animals who are aged ≥ 37 years.

The findings showed that 87.8% of the patients in group 2 (< 37 years old) were patients who applied to the city center. The subgroup variable that had the most significant effect on the variable in group 2 was gender. Among the patients in group 2, 81.5% of the male gender applied in the city center. The variable affecting the male gender was the season. It was determined that 71.7% of the patients who were < 37 years old and were male and whose contact season with animals was spring-winter-autumn applied in the city center. 94% of the male patients aged < 37 whose contact season with animals was summer applied to the hospital in the city center. Among the patients in group 2, the rate of female patients who applied in the city center was 94.1%. The factor affecting the patients whose age was < 37 and whose gender was female was the animal species variable. 85.7% of the female patients aged < 37 years who were injured by dogs and other animals applied in the city center. Among female patients aged < 37 years, the rate of those who were injured by cats and applied to the hospital in the city center was 98.4% (Figure 1).

Discussion

Animal bites are a crucial health problem worldwide, mainly affecting men and young population. Rabies transmitted from animals is a disease that can be prevented by vaccination but is still prevalent in 150 countries. Avoiding transmission is possible by preventing bites and vaccinating animals, especially dogs (available from: <https://www.who.int/news-room/fact-sheets/detail/rabies>, Accessed on Nov 28, 2022). As in our country, in countries where the number of stray animals is high, animal vaccinations cannot be administered fully and adequately. It has been reported in some publications that even vaccinations of domestic animals are neglected [7,8]. Therefore, regarding animal contact identifying at-risk groups may contribute to reducing animal attacks. In this study, to our knowledge, for the first time, the risk factors for exposure to animal attacks in rural and urban areas were investigated in the literature.

The first factor in exposure to animal attacks in the city

and district centers was age. The majority of the patients presenting to the city center are < 37 years old, and the majority of the patients applying to the district center were aged ≥ 37 years. In addition, a statistically significant difference was found between the mean age of the patients in the city center and the district center, ($p < 0.001$). Young patients are at risk of being exposed to animal attacks in the city center since the population living in the district center is older. Population density is high in the city center, and young people spend more time outside due to factors, such as work, school, social life, and entertainment. The average age reported in studies conducted, both in Turkey and abroad, and the average age found in this study are similar [9-13].

For the patients in group 1, the primary reason for exposure to animal attack was identified as the animal being a domestic or stray animal. It was determined that the majority (76.9%) of those who contacted domestic animals applied to the district center. Since the district center where the present study was conducted is a region where agriculture and livestock are common and the majority of the locals live in separate households, living conditions are more suitable for animal care in gardens and houses. Hence, we believe the risk of injury by domestic animals is higher in the district center. In group 1, the rate of bite injuries is higher in the city center, whereas the rate of scratch injuries is higher in the district center. The inability of people living in the city center to predict animal behavior and the fact that they might have a limited escape area may increase the risk of being bitten. Those living in the district center can establish closer contact and bonds with animals; thereby, they are exposed to minor injuries in the form of scratching.

The first factor affecting the patients in group 2, according to the mean age, was gender. When examining the risk factors regarding gender for the patients in group 2 who applied to the city center, the summer season for men and exposure to cat attacks for women were found to come forward. According to our findings, male patients aged < 37 years applied during the summer period in the city center. The geographical, climatic, and socioeconomic characteristics of our province (the city center is located on the coast, has a temperate climate and is a tourist city) could explain why this patient group is at risk as well as the fact that schools are closed during the summer period and especially children and young people spending more time outdoors in the summer. In support of this finding, Loder et al. [14] reported their evaluation of dog bites in the United States, as most cases occurred during spring and summer. Likewise, Gündüz et al. [9] reported that most cases were seen in spring and summer. However, according to our findings, the situation in the district center is different. The injury rate of male patients in group 2 from the district center in the spring, winter and autumn seasons is more than four times compared to the summer season. In the district center where the study was carried out, the main income sources are agriculture and livestock. Especially the young population living in this area works intensively in the fields or goes to the highlands in summer. We think spending time in the district center in seasons other than summer increases the risk of animal contact.

The factor affecting the female patients in group 2 was

determined as the animal species. According to our findings, 98.4% of the female patients aged 0-37 who were injured by a cat applied in the city center. Contact with a cat in the city center is a risk factor for the female gender. Ting et al. [13] found in their study that cat bites were seen significantly more frequently in women than in men (27.9% vs. 72.1%). The fact that cats look smaller and more harmless than dogs may be a factor that increases contact with cats, especially for the female gender and children group.

When the parameters discussed in the study are compared between the city and district centers, the results support our risk determination results. The rate of bite injuries in the city center was twice as high as scratch injuries. The reason for this situation is stated and interpreted in the results of CHAID analysis. Although the type of injury differs between regions, injuries in both regions were mostly at the upper extremity and originated from dogs. It was concluded that there was no relationship between the type of injury and the injured area and animal species. In many previous studies, it was reported that the most injured area was the upper extremity, consistent with the findings obtained in our study [9,10,12,13].

Algorithms have been developed to create a common approach to animal bites in our country. However, different approaches and treatment protocols can be encountered in the world. These differences may be due to geographical, sociocultural, and socioeconomic reasons. In a study conducted in Europe, Pfortmueller et al. [12] reported a similar rate of surgical treatment and hospitalization, whereas a significantly higher rate of antibiotic treatment compared to our results. In Australia, according to the rates determined in our study, it is seen that antibiotic treatment is approximately 2 times higher and surgical treatment is approximately 4 times higher [13]. Ig treatment is expensive, and the number of patients who can reach this treatment is directly related to the country's socioeconomic status. In a recent study from our country, Canpolat et al. [4] reported that 55% of the patients were treated with Ig, while in India, Gogtay et al. [11] stated that only 2.7% of the patients were treated with Ig therapy. It is aimed to vaccinate all patients with suspected rabies contacts. While all the patients in the district center are immunized with the full dose, it was observed that a very small part of the patients in the city center are not vaccinated with the full dose. There is only one rabies practice and treatment center in the district center and all applications, and patient follow-ups are carried out from that single center. However, there are seven rabies vaccination and treatment centers in the city center (available at: <https://izmirism.saglik.gov.tr/TR-161371/kuduz-asi-uygulama-merkezleri.html>, Accessed on Nov 28, 2022 Nov 28). Therefore, patients can apply to another center to continue vaccination after the first application. Higher rates of antibiotic therapy, Ig, surgery, and hospitalization in the city center may be associated with the number of bite injuries [4,5,15]. In addition, due to the lack of relevant specialists in some district center hospitals, referral of patients requiring advanced treatment to the central hospital where this study was conducted effectively increases this rate.

Conclusion

Risky rabid animal contact affects the young population,

especially men in our country. The young population in the city center and the elderly population in the district center are more affected. Summer is a risk factor for young men, and for young women, cat attacks are a risk factor. For the elderly population, living in the city center is a risk factor for being bitten. During this study, one of the two children who were attacked by a stray dog in another district center died due to rabies. It has become even more critical to reorganize animal reclamation actions, raise awareness of society and take necessary precautions by revealing risk factors. We think that our study is illuminating in this respect.

Limitations

Our first limitation is that this study is retrospective. Some of the patients' admission dates to the hospital coincided with the COVID-19 pandemic period. Since more data could not be obtained from other district center hospitals connected to the city center where this study was conducted, comparisons with other districts could not be made.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Conflict of interest

The authors declare no conflict of interest.

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